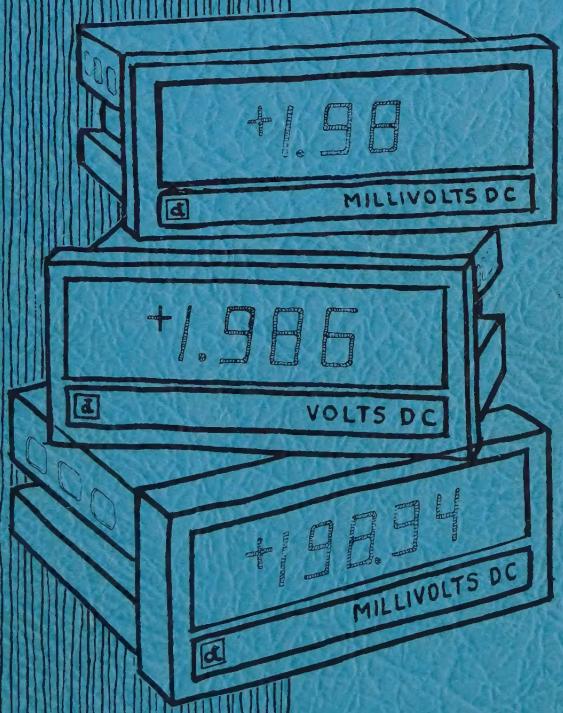
4½ DIGIT

Panel Instrument

MODELS 4411 and 4412



Instruction Manual

DATA TECHNOLOGY CORPORATION

Instruction Manual

4½ DIGIT

Panel Instrument

MODELS 4411 and 4412

SM2003

P/N 547981

DATA TECHNOLOGY CORPORATION
2700 South Fairview Street, Santa Ana, California 92704
714- 546- 7160

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INTRODUCTION

This technical manual consists of six sections — I, General Description and Specifications, II, Installation and Operation, III, Theory of Operation, IV, Calibration and Troubleshooting, V, Special Modifications, and VI, Drawings and Parts Lists. These sections describe models 4411 and 4412 Digital Panel Meters manufactured by Data Technology Corporation, 2700 South Fairview Street, Santa Ana, California 92704.

The information contained in Sections I and II is normally all that is required for operating the equipment. Sections III, IV, and VI provide data applicable to the equipment's calibration or repair.

Section V of this manual provides detailed descriptions of non-standard or modified assemblies. For modified assemblies, please read this section before operating the equipment.

SECTION I

GENERAL DESCRIPTION AND SPECIFICATIONS

1-1. GENERAL DESCRIPTION

1-2. The Data Technology models 4411 and 4412 are four and one-half digit digital panel meters. The meters are available as voltmeters or ammeters. Any of 22 voltage and current ranges may be specified. See Table 1-1 for model numbers and input ranges.

Table 1-1. Model Descriptions

Unipolar Model No.'s	Bipolar Model No.'s	Range
4411-01	4412-01	200 mV
4411-02	4412-02	2 V
4411-03	4412-03	20 V
4411-04	4412-04	200 V
4411-05	4412-05	1000 V
4411-06	4412-06	2 μA
4411-07	4412-07	20 μA
4411-08	4412-08	200 μA
4411-09	4412-09	2 mA
4411-10	4412-10	20 mA
4411-11	4412-11	200 mA

1-3. The meter converts the ANALOG INPUT to a digital number and displays that number decimally. The conversion rate is controlled internally at four to six conversions per second; however, an external HOLD control line may be used to terminate conversions. The display continues to indicate the previous reading when the HOLD is activated.

1-4. The conversion technique employed is "dual slope integration." This technique in conjunction with a conversion rate held in sync with the 60 Hz power frequency and an auto zero input amplifier circuit yields a significant degree of noise immunity and accuracy.

1-5. The unit indicates overrange for readings above $\pm$19999 by flashing the most significant digit lamp.

1-6. INPUT-OUTPUT FEATURE

1-7. The standard meter is equipped with a connector through which ac power and analog input connections are made. The decimal point is also established via this connector. The digital lines shown in Table 1-2 are available for use in data gathering systems.

Table 1-2. Input-Output Lines

Input Line	Output Lines
$\overline{\text{HOLD}}$	POLARITY
	BCD DATA (17)
	$\overline{\text{PRINT}}$ COMMAND
	OVERRANGE

1-8. OPTIONS

1-9. Units with a C2 option include connectors for the meter's J1 and J2. Special modifications are incorporated in models with the suffix -2 added to the model number. See Section V for special modifications.

1-10. SPECIFICATIONS

1-11. See Table 1-3.

Table 1-3. Specifications

GENERAL COMMENTS

Unit is non-blinking readout with flashing overrange.

PHYSICAL CHARACTERISTICS

Size ..... 4.787 x 4.05 x 1.8 in
Weight ..... 19 oz
Case Material ..... styrene acrillic butadyene 20% glass filled

Note

Amplifier is allowed to settle for 8-1/3ms (light period). t1-t2 time is completed within 11ms nom (dark period).

ENVIRONMENT

Operating ..... 0 — 60°C @ 80% RH
Storage ..... -10 — +85°C

POWER REQUIREMENTS

Standard ..... 105 — 125V 60 Hz @ 8W
Special Option ..... +5Vdc ±5% (inc reg) @ 0.45A (max)
±15Vdc ±1% (inc reg) @ 0.02A (max)
+28Vdc ±1% (inc reg) @ 0.02A (max)
200Vac pk ±15% @ 0.024A pk
Total power approx 6W

ANALOG INPUT CHARACTERISTICS

Analog inputs are "high" and "low" with analog and digital ground interconnected.

Range	Resolution	Input Impedance (Ω)	Input Bias Current (Max)	Maximum Input W/O Damage	
				Continuous	Instantaneous
±199.99mV	10 μV	10^9	100pA @25°C	250Vdc	550Vdc
±1.9999V	100 μV	10^9	100pA @25°C	250Vdc	550Vdc
±19.999V	1mV	10^7	10pA @25°C	1kVdc	1k Vdc
±199.99V	10mV	10^7	0	1kVdc	1k Vdc
±1000V	100mV	10^7	0	1kVdc	1k Vdc
±199.99nA	10pA	10^6	*±10ppm		
±1.9999μA	100pA	10^5	*±20ppm		
±19.999μA	1nA	10^4	*±20ppm		
±199.99μA	10nA	10^3	*±20ppm		
±1.9999mA	100nA	10^2	*±30ppm		
±19.999mA	1μA	10	*±30ppm		

*Input resistor temperature coefficient per °C.

Table 1-3. Specifications (Continued)

PERFORMANCE

Accuracy

24 hr @ 23°C ..... ±(0.01% rdg +0.02% FS)

60 days @ 10 — 40°C

Voltage Ranges ..... ±(0.02% rdg +0.05% FS)

Current Ranges ..... ±(0.02% rdg +0.08% FS)

Conversion Time (Reset to Print) ..... 19-1/3ms (max)

Settling Time (0V — ±FS) 700ms

Note

Maximum condition is time from CONVERT COMMAND to PRINT COMMAND; t1-t2 time is 11ms (max).

Read Rate

Standard 5/s

Optional (Internal Control) ..... 0.1 — 15/s

Special Option (using $\overline{\text{HOLD}}$ Control) ..... multiples of 16-2/3ms (due to 60Hz sync)

Noise Rejection

NMR ..... 34dB @ 60Hz (2 real poles at input with 12Hz corner freq)

CMR ..... 100dB w/1kΩ unbalance in either input; from 60Hz to 100kHz

CMV (when DATA lines are not used) 500V

DIGITAL I/O LINES

DTL, TTL compatable positive true positive logic levels as follows:

Logic "1" ..... 2.4 — 5.5V

Logic "0" ..... 0 — 0.4V

Output Drive ..... 4 TTL UL or 6.4mA (min)

Input Loading ..... 3.5mA (max)

DATA Lines

17 BCD coded lines + polarity

OVERRANGE

"1" = OVERRANGE

"0" = In Range

$\overline{\text{PRINT}}$ COMMAND

"0" = Valid Data Output Levels

"1" = Unit Converting

Table 1-3. Specifications (Continued)

$\overline{\text{HOLD}}$

"1" (open collector or equiv) = Convert

"0" = Hold Conversions

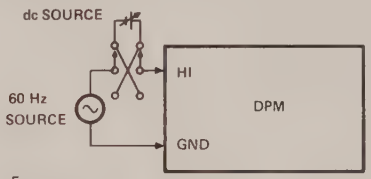
DECIMAL POINT (4)

"0" = Illuminated Decimal Point

Note

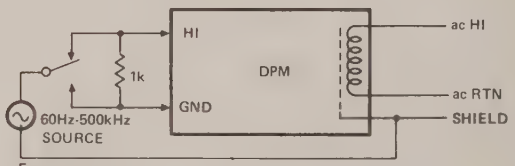
DECIMAL POINT drive circuitry must be able to withstand 80V (OFF condition).

TEST CIRCUITS



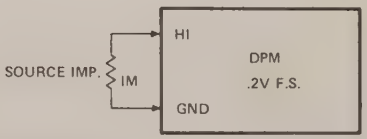
$$\text{NMR dB} = 20 \text{ LOG } \frac{E_{NM\,pk\text{-}pk}}{E\ READOUT_{pk\text{-}pk}}$$

TEST CIRCUIT FOR NMR



$$\text{CMR dB} = 20 \text{ LOG } \frac{E_{CMpk\text{-}pk}}{E\ READOUT\,pk\text{-}pk}$$

TEST CIRCUIT FOR CMR



$$\text{INPUT BIAS} = \frac{E\ READOUT}{\text{SOURCE IMPEDANCE}}$$

TEST CIRCUIT FOR INPUT BIAS

SECTION II

INSTALLATION AND OPERATION

2-1. INSTALLATION

2-2. Mounting (Figure 2-1)

2-3. The meter may be mounted in a 1.682 ±.010 by 3.924 ±.010 inch panel cutout. To mount, remove the snap-on meter bezel; rotate the pawl screws several turns counter clockwise to retract pawls; insert meter in panel; tighten pawl screws, and replace bezel. See Figure 2-2 for dimensions. Do not obstruct the vent holes on either side of the meter case.

2-4. Wiring

2-5. Any of the following connectors may be used for J1:

Elco-Type 00-6007-030-980-002

Viking-Type 2VK15D2/1-2

Masterite-Type MC15D/1-2

Cinch-Type 251-15-30-160

Data Technology Part No. 531768-007

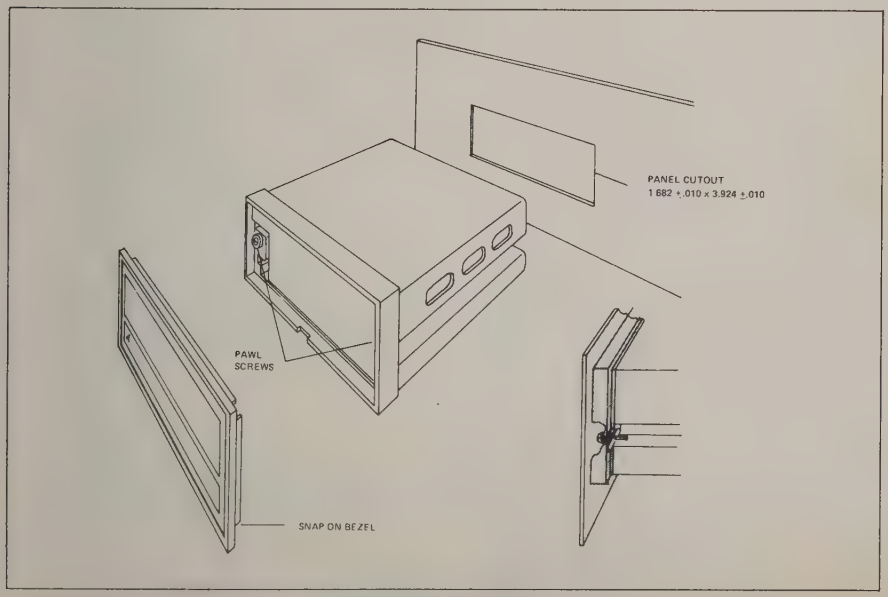


Figure 2-1. Mounting

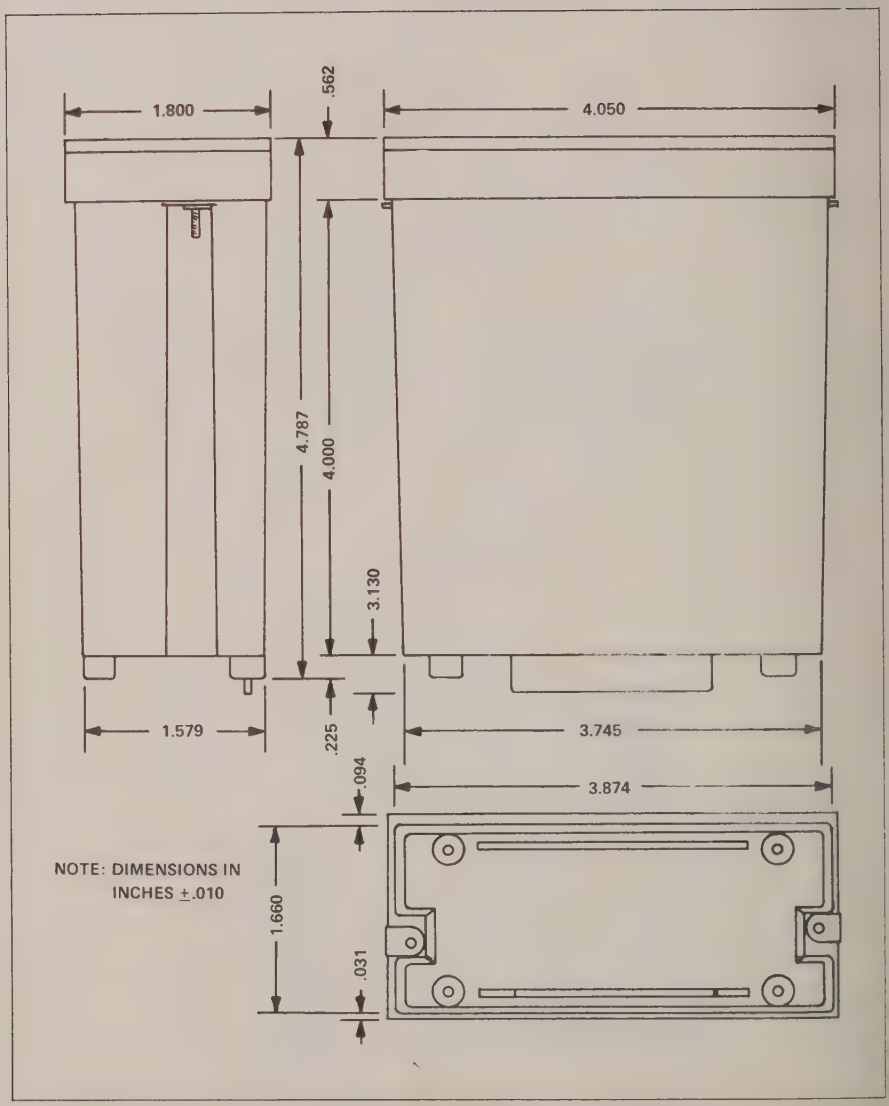


Figure 2-2. Dimensions

2-6. If access to J2's digital input-output lines is required, any of the following connectors may be used:

Elco-Type 00-6007-020-980-002

Viking-Type 2VK10/1-2

Masterite-Type MC10D/1-2

Cinch-Type 251-10-30-160

Data Technology Part No. 531768-006

2-7. These connectors are attachable at the rear of the meter case using the hardware provided. (See Figure 2-3).

2-8. Using Table 2-1, connect 115 volts ac; connect the shield to SYSTEM GROUND; connect the source to be measured between the appropriate ANALOG INPUT and ANALOG GROUND, and, when applicable, establish the decimal point.

2-9. If the meter is used in a darkened environment, do not ground the pin numbers as prescribed in Table 2-1 for decimal point illumination, instead, connect jumpers per Table 2-3.

2-10. If the digital input-output lines are used, refer to Table 2-2 for pin assignments and paragraph 2-10 for operation. If the model number includes a suffix -2, refer to Section V.

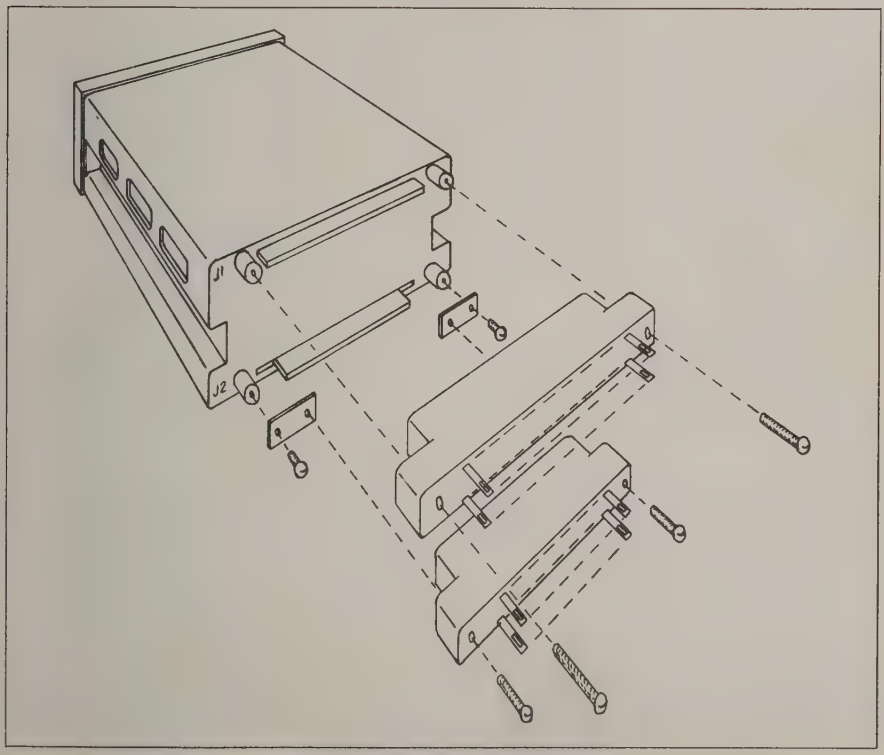


Figure 2-3. Connector Mounting

Table 2-1. Analog Connections

J1 Pin	Signal	J1 Pin	Signal
A	Analog in for 20V, 200V, 1kV meters	1	-15V
B		2	Analog in for 200mV, 2V, and all ammeters
C		3	
D		4	
E	+28V	5	
F	+200pk	6	
H	Display Decimal Point	7	
J	Display Keep-Alive	8	
K	$\overline{\text{HOLD}}$	9	
L	OVERRANGE	10	ANALOG GND
M	+5V	11	GND for Decimal Pt. 1.8888
N	DIGITAL GND	12	GND for Decimal Pt. 18.888
P	+15V	13	GND for Decimal Pt. 188.88
R	SHIELD	14	GND for Decimal Pt. 1888.8
S	115V ac RTN	15	115V ac HI

Table 2-2. Digital Connections

J2 Pin	Signal	J2 Pin	Signal
A	1 x 10^0 BCD DIGIT	1	4 x 10^0 BCD DIGIT
B	2 x 10^0 BCD DIGIT	2	DIGITAL GND
C	1 x 10^1 BCD DIGIT	3	8 x 10^0 BCD DIGIT
D	2 x 10^1 BCD DIGIT	4	4 x 10^1 BCD DIGIT
E	1 x 10^2 BCD DIGIT	5	8 x 10^1 BCD DIGIT
F	$\overline{\text{PRINT}}$	6	4 x 10^2 BCD DIGIT
H	2 x 10^2 BCD DIGIT	7	8 x 10^2 BCD DIGIT
J	1 x 10^3 BCD DIGIT	8	4 x 10^3 BCD DIGIT
K	2 x 10^3 BCD DIGIT	9	8 x 10^3 BCD DIGIT
L	1 x 10^4 BCD DIGIT	10	POLARITY (+)

Table 2-3. Decimal Point Jumpers for Dark Environments

Decimal Point	Jumpers
1.8888	J1-H to J1-11 and J1-J to J1-14
18.888	J1-H to J1-12 and J1-J to J1-14
188.88	J1-H to J1-13 and J1-J to J1-14
1888.8	J1-H to J1-14 and J1-J to J1-11
18888	33MΩ from J1-H to J1-14 and J1-10 to J1-11

CAUTION

The dc voltages in Table 2-1 are available at the connector to facilitate flexibility in special situations. These voltages are not intended for use as a source to external systems.

2-11. OPERATION

CAUTION

If the most significant digit lamp flashes, an overrange condition exists. Excessive overrange levels may cause damage to the meter. Remove the ANALOG INPUT and determine that any overrange level is within specified limits. (See Table 1-3).

The models 4411-05 and 4412-05 have maximum ranges of 0 to 1000 and ±1000 volts. No overrange flash occurs at >1000 and ≤1999 volts to warn the user. Do not apply analog levels in excess of 1000 volts.

A flashing most significant digit lamp invalidates the displayed number and BCD data.

2-12. No special instructions are required when the DIGITAL INPUT-OUTPUT lines are not used. The units begin operating upon receipt of the inputs prescribed in paragraph 2-4; if not, refer to the warranty for proper action.

2-13. DIGITAL INPUT-OUTPUT Lines

2-14. The DIGITAL OUTPUT lines are DTL and TTL compatable, with positive true positive logic levels as follows:

"1" = +2.4 to +5.5 volts

"0" = 0 to +0.4 volts

2-15. BCD OUTPUT LINES (17)

2-16. The 17 lines labeled BCD DIGIT provide binary coded decimal logic levels representative of the ANALOG INPUT.

2-17. OVERRANGE OUTPUT LINE

2-18. The OVERRANGE line is a "1" for "off scale" readings (greater than 19999 decimally) and a "0" for "in scale" readings.

2-19. POLARITY (+) OUTPUT LINE

2-20. The POLARITY (+) line is a "1" for positive input levels and a "0" for negative levels.

2-21. $\overline{\text{PRINT}}$ OUTPUT LINE

2-22. The $\overline{\text{PRINT}}$ line is a "0" during the times the other output lines carry valid data and a "1" during times the output lines are changing due to the conversion process. (See Figure 2-4).

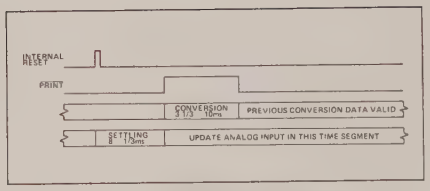


Figure 2-4. $\overline{\text{PRINT}}$ Output Timing

2-23. $\overline{\text{HOLD}}$ INPUT LINE

2-24. A "0" at the $\overline{\text{HOLD}}$ input inhibits conversions. Previous conversion data remains stored and available at the BCD output lines and display when $\overline{\text{HOLD}}$ is made a "0." The next conversion is started about 200 milliseconds after $\overline{\text{HOLD}}$ is returned to a "1."

2-25. For single conversion operation, allow the $\overline{\text{HOLD}}$ line to remain a "1" until the $\overline{\text{PRINT}}$ line goes to a "1." Return the $\overline{\text{HOLD}}$ to a "0" within the following 250 milliseconds to prevent additional conversions. For faster rates, consult Data Technology regarding special modifications.

2-26. The $\overline{\text{HOLD}}$ driving circuitry must be open collector or equivalent. Figure 2-5 shows a $\overline{\text{HOLD}}$ drive circuit which is compatible with DTL and TTL logic levels. Note the inversion.

2-27. DECIMAL POINT INPUTS

2-28. The drive circuitry to the DECIMAL POINT inputs, if used, must be capable of withstanding 80 volts when OFF. This requirement does not cover the dark environment criterion specified in paragraph 2-9.

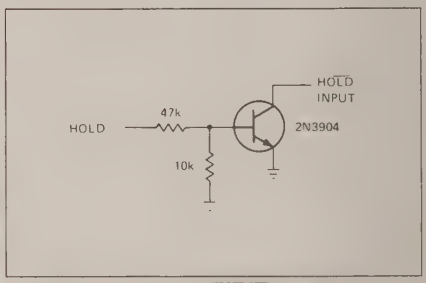


Figure 2-5. Typical $\overline{\text{HOLD}}$ Drive Circuit

SECTION III

THEORY OF OPERATION

3-1. GENERAL DESCRIPTION

3-2. Dual Slope Integration

3-3. The models 4411 and 4412 employ the dual slope integration technique of converting analog levels to digital numbers. See Figure 3-1. The integrating capacitor charges to a level proportional to the ANALOG INPUT during t1 time. During t2 time, the charge current to the capacitor is constant and the reverse of the t1 current, returning the capacitor to the original level. When the original level (zero detect) is reached, the t2 count is entered into the display storage, and the number viewed corresponds to the input level.

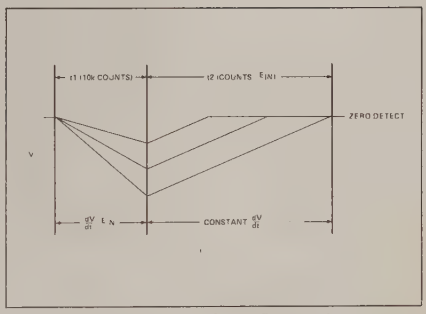


Figure 3-1. Dual Slope Integration

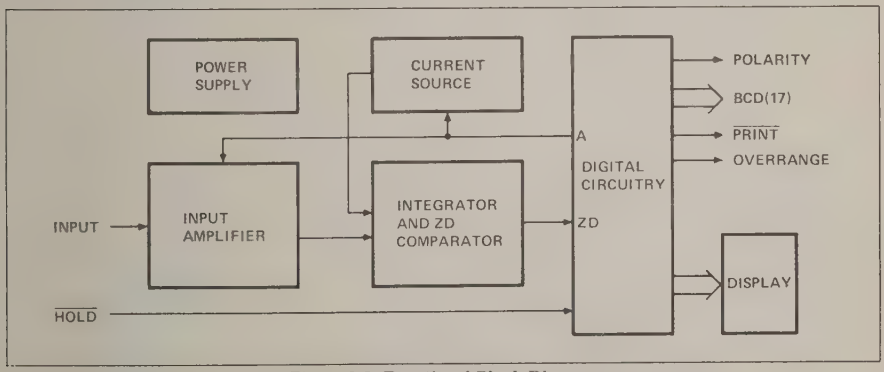


Figure 3-2. Functional Block Diagram

3-4. Functional Block (Figure 3-2)

3-5. The input amplifier is a differentiate and hold circuit, with t1 as hold time. The outputs of the amplifier provide unidirectional current during t1 time and polarity information. During t2 time, the amplifier output is decoupled, and the charge of the integrator capacitor is determined by a current reference. When current from the current reference returns the capacitor to the original level, the integrator and zero detect circuitry transmitts ZERO DETECT (ZD). ZD establishes t2 time.

3-6. The digital circuitry establishes t1 time and conversion rate. The circuitry contains a counter, whose outputs at ZD time are a BCD coded number corresponding to the input level.

3-7. INPUT AMPLIFIER

3-8. The input amplifier is a differentiator between t1 times and switched to a hold circuit during t2 time. See Figure 3-3.

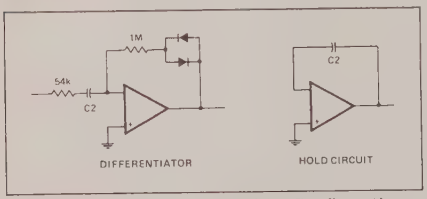


Figure 3-3. Basic Input Amplifier Configurations

3-9. In the differentiator configuration, C2 charges to the input voltage. When the charge is complete, the output of the amplifier is less than plus or minus the diode voltage. In the hold configuration, C2 determines the output voltage. Thus, the differentiator samples the input voltage, and the hold circuit holds that voltage during t2 time.

3-10. Figure 3-4 shows the input amplifier circuitry. Q1 and Q3 are OFF in the differentiate mode and ON in the hold mode. With Q3 ON, diodes CR3 and CR4 are both non-conductive, decoupling R15 from the summing junction. The current gain of the amplifier is controlled by the value of the transconductance (GM) resistor.

3-11. Depending on polarity, either Q6 and Q7 or Q8 and Q9 are conducting. Current through Q8 and Q9 controls the voltage to the non-inverting input of A2 which, in turn, biases Q10 into conduction. Thus, output current is unipolar through either Q6 and Q7 or Q10. R26 is a balance control, so that, like input voltages having opposing polarities produce the same output current. R30 controls the bias to Q10. Q5 senses input polarity. The bandwidth is controlled by R7 and C1 and R8 and C2. CR1 and CR2 are clamps that protect against excessive input voltages.

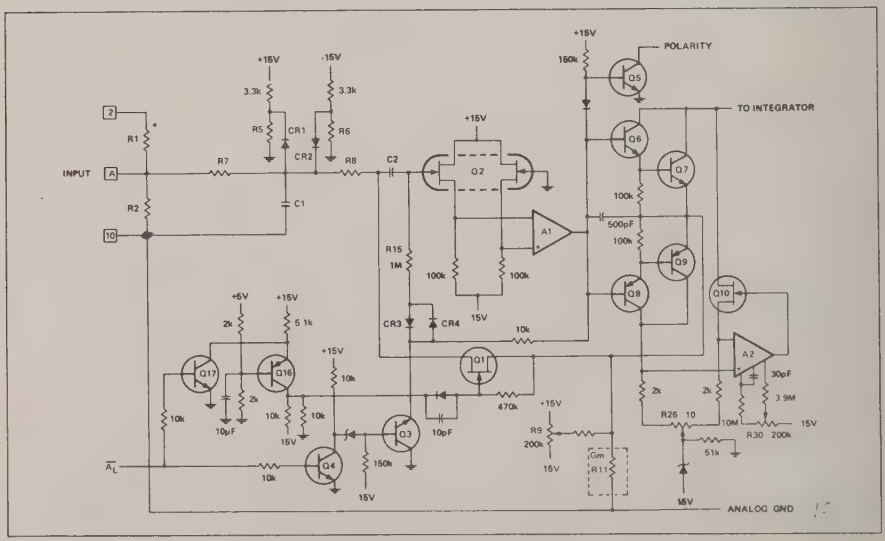


Figure 3-4. Input Amplifier

3-12. The component values which differ with each model are shown in Table 3-1.

3-13. INTEGRATOR COMPARATOR AND CURRENT SOURCE (Figure 3-5)

3-14. During t1 time, "A" is a logical "1," Q12 and Q13 are ON and Q11 is OFF. CR6 and CR8 are non-conductive, and current through CR7 is proportional to the level presented to the input amplifier. Under these circumstances, C9 integrates in the negative direction.

Table 3-1. Attenuator and Gm Values

Range	R1	R2	R5-6	R8	R10	R11	C1	C2	Input
±200mV	open	open	56Ω	56k	2.2M	100Ω	.1μF	.22μF	2
±2V	open	open	560Ω	56k	22M	1k	.1μF	.22μF	2
±20V	9.9M	1.1M	560Ω	560k	22M	1k	.22μF	.002μF	A
±200V	9.9M	100k	560Ω	56k	22M	1k	.047μF	.002μF	A
±1000V	9.9M	10k	560Ω	56k	22M	100Ω	.1μF	.002μF	A
±2μA	open	100k	56Ω	56k	2.2M	100Ω	.047μF	.002μF	2
±20μA	open	10k	56Ω	56k	2.2M	100Ω	.1μF	.002μF	2
±200μA	open	1k	56Ω	56k	2.2M	100Ω	.1μF	.002μF	2
±2mA	open	100Ω	56Ω	56k	2.2M	100Ω	.1μF	.002μF	2
±20mA	open	10Ω	56Ω	56k	2.2M	100Ω	.1μF	.002μF	2
±200mA	open	1Ω	56Ω	56k	2.2M	100Ω	.1μF	.002μF	2

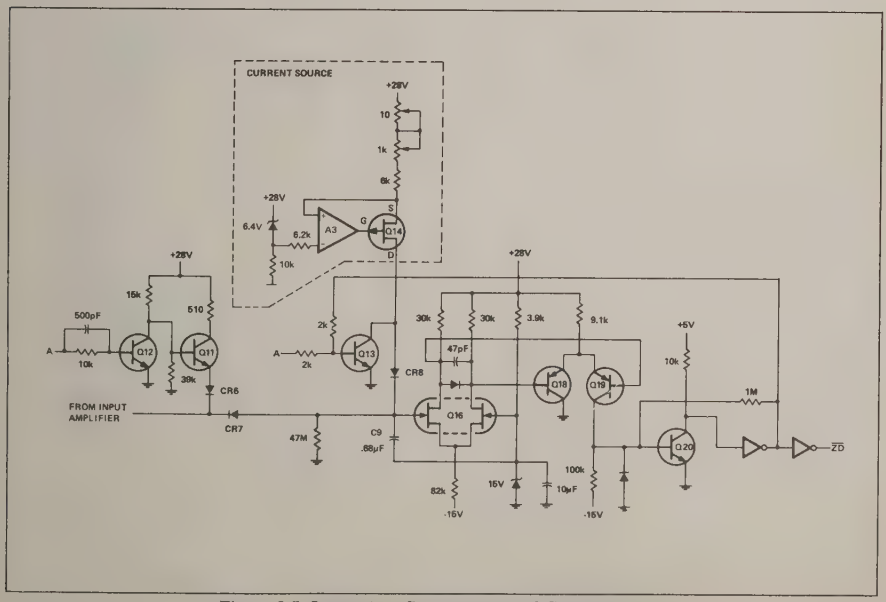


Figure 3-5. Integrator, Comparator, and Current Sources

3-15. When "A" goes to a "0," Q12 and Q13 turn OFF and Q11 turns ON. CR7 is non-conductive, decoupling the input amplifier. Current from the current source now causes C9 to integrate in the positive direction.

3-16. The threshold of the comparator is set at +15 volts. When integration brings the input of the comparator to +15 volts, the comparator changes state transmitting ZERO DETECT (ZD). With ZD, a feedback loop is formed, whereby, the control of the current source by Q13 maintains C9 at the ZD Level.

3-17. The above process repeats when a new conversion is initiated, making "A" a "1."

3-18. DIGITAL CIRCUITRY (Figure 3-6)

3-19. The digital circuitry consists of a counter comprised of four divide-by-ten counters and a divide-by-five counter. Clocking of this counter establishes t1 time, OVERRANGE, and BCD outputs representative of the input level.

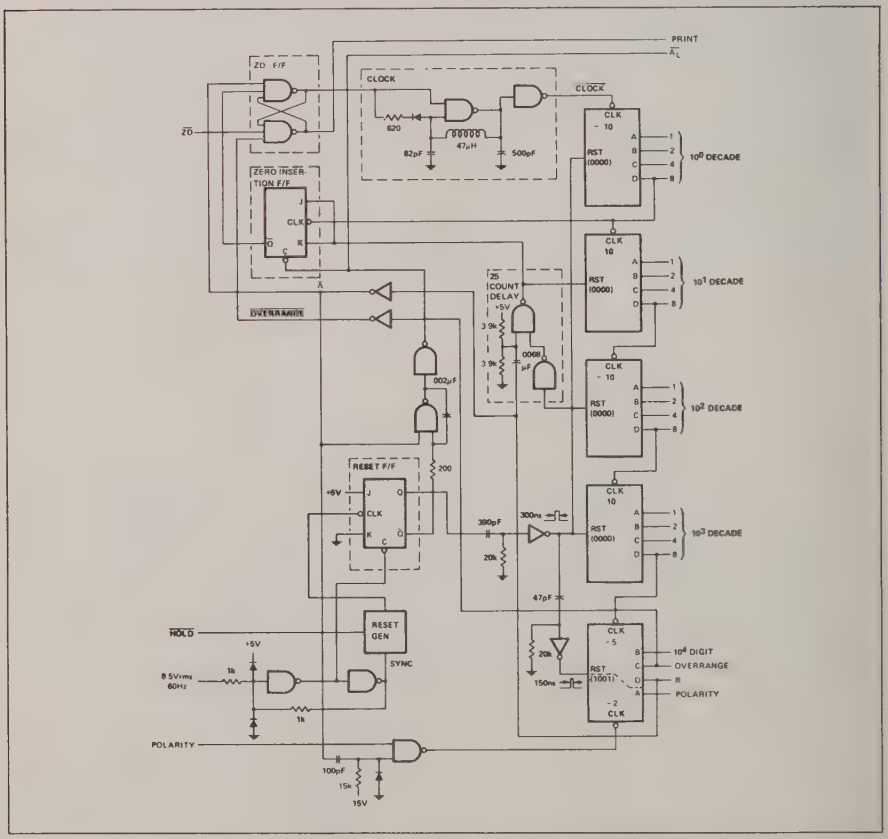


Figure 3-6. Digital Circuitry

3-20. Counter Reset

3-21. The conversion is started when the reset generator emitts a pulse, clocking the reset flip-flop. This pulse is in sync with the zero crossing of the 60 Hz line frequency. Eight and one-third milliseconds later the reset flip-flop is cleared back to the reset state by the 60 Hz sync signal. The "Q" output of the flip-flop drives two cascaded one-shot's that reset the BCD and OVERRANGE outputs to "0's" and the POLARITY and "A" outputs to "1's." See Figure 3-7 for reset timing.

3-22. Counter Clocking

3-23. Basically, the ZD flip-flop enables the clock circuit at reset time and inhibits the clock at ZD time. Actually, the ZD flip-flop may be set by either the "$\overline{A}$" signal or the zero insertion signal and reset by either the $\overline{ZD}$ signal or the $\overline{OVER\text{-}RANGE}$ signal. These signals as well as the 25-count delay circuit are explained as follows:

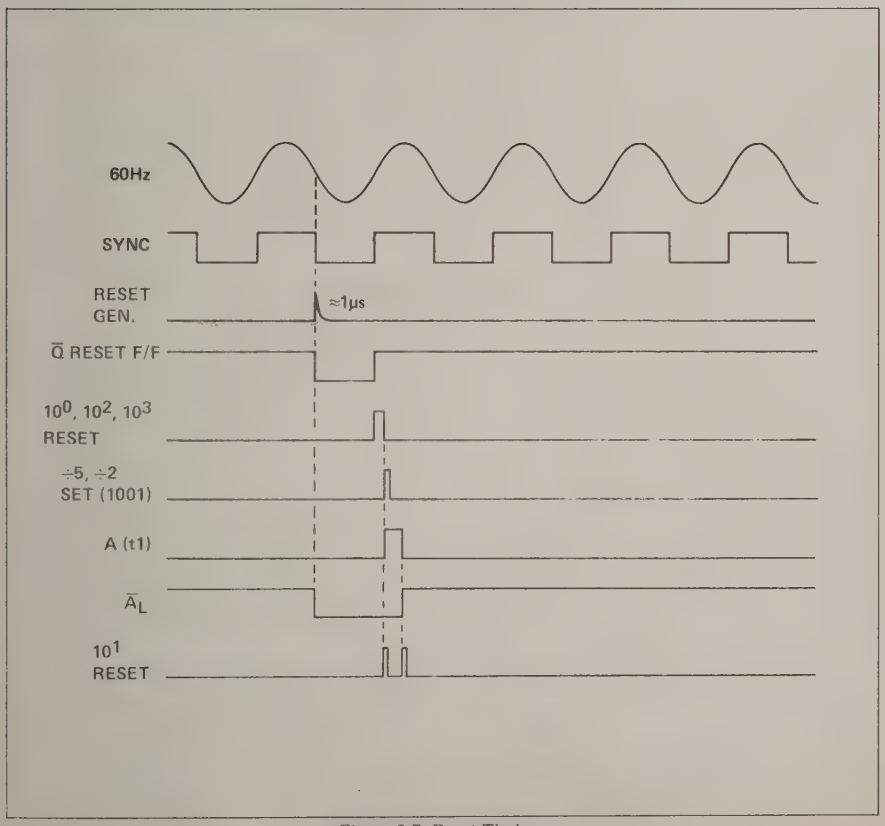


Figure 3-7. Reset Timing

3-24. COUNTER TIMING

3-25. The counter output waveforms shown in Figure 3-8 may be terminated and stored at any point within the t2 range. The termination point is determined by the point ZD occurs. When ZD occurs in the OVERRANGE area, the 10k digit is clocked OFF and the OVERRANGE clocked ON. With the 10k digit clocked ON and OFF flashing of the corresponding light occurs. Since either $\overline{ZD}$ or $\overline{OVERRANGE}$ resets the ZD flip-flop, the clock is inhibited with OVERRANGE.

3-26. 25-COUNT DELAY

3-27. The ZD signal incurs delays due to the bandwidth of the comparator. The delay circuit corrects for these delays by causing the 10^1 decade to be reset through the first 10^1 decade clock. This reset effectively takes 20 counts out of the sequence at the beginning of t2 time. Although 20 counts is more than is necessary, integration current during t2 time is added to provide the complete correction. For example: with a 0-volt input, correction integrator current is added which causes a ZD coincident with 20 counter counts, but, since the 10^1 decade is not clocked, the counter output is all "0's."

3-28. ZERO INSERTION

3-29. To understand zero insertion, imagine what happens when ZD occurs in the 20 counts following t1 time. Terminating the count in this area could yield a readout between 00001 and 00009.

3-30. Although ZD only occurs during this time when a calibration is necessary, a slightly out-of-calibration condition may cause readings difficult to justify near 0-volt inputs. To avoid the resultant confusion, the zero insertion flip-flop forces the clock to remain enabled through the 20 count clock removal time.

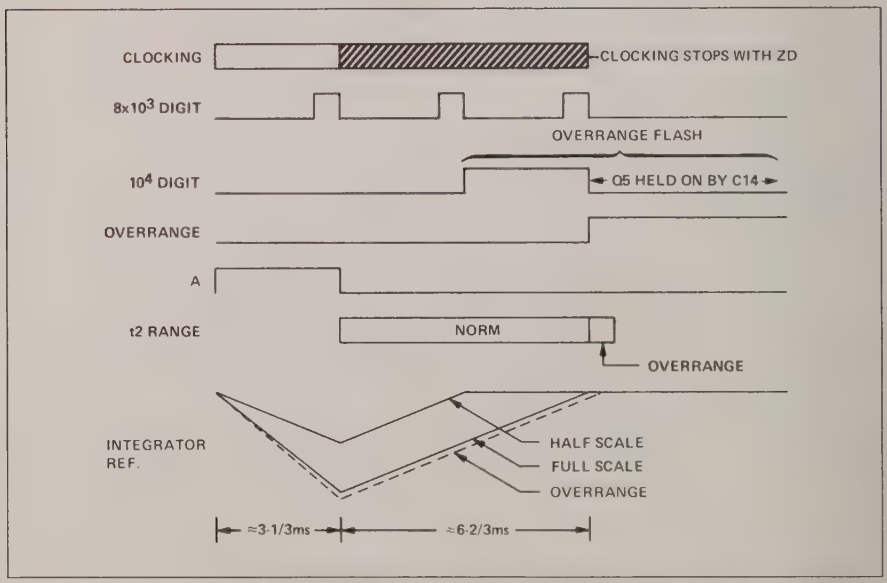


Figure 3-8. Counter Output Waveforms

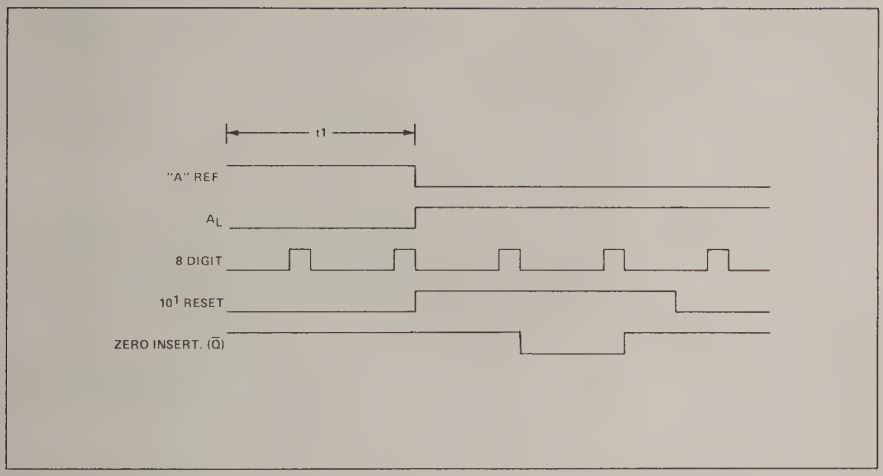


Figure 3-9. Zero Insertion Timing

3-31. Figure 3-9 shows input and output waveforms to the zero insertion flip-flop, as well as "A." Note that zero insert is a "0" for a 10 count duration 10 counts after t1 to 20 counts after t1.

3-32. Polarity (Figure 3-6)

3-33. The divide-by-two flip-flop is set to a "1" at reset time. "$\bar{A}$" is gated with the POLARITY output of the input amplifier. With negative polarities, the divide-by-two flip-flop is clocked to a "0" by "$\bar{A}$." For positive polarities, this clock is inhibited, and the flip-flop remains in the set state.

3-34. Reset Generator (Figure 3-10)

3-35. A15 is a programmable unijunction that turns ON when C2 charges to the trigger level established by program resistors R3 and R4. With A15 ON, C2 discharges through A15 and R7, turning A15 OFF. R5 and C2 determine the reset rate and are normally set for four to six conversions per second. The 60 Hz signal at the gate of A15 maintains synchronization with the line frequency. With the $\overline{\text{HOLD}}$ input grounded, A15 is held OFF.

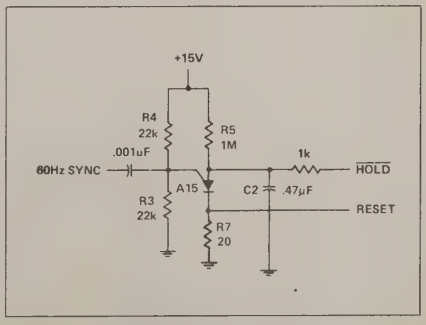


Figure 3-10. Reset Generator

3-36. DISPLAY CIRCUITRY

3-37. BCD to seven segment converters convert the counters BCD outputs to numbers that yield decimal lamp readouts. Figure 3-11 shows the circuitry for one decade and the plus, minus, and 10^4 digit circuit.

3-38. POWER SUPPLY (Figure 3-12)

3-39. ±15 Volt Supply

3-40. The ±15 volt supply employs two half-wave rectifiers into a silicon general incorporated model SG3501 integrated circuit regulator.

3-41. +5 Volt Supply

3-42. The +5 volt circuitry employs a full-wave rectifier and capacitance-input filter. Q22 of the regulator is biased ON with 5 volts on the base. With Q22 ON, Q21 turns ON. When the voltage at the collector of Q21 tries to exceed +5 volts, CR22 conducts, turning Q22 OFF sufficiently to maintain a +5 volt output.

3-42. With excessive output loads causing the output voltage to drop below 5 volts, CR23 conducts, turning Q21 and Q22 OFF.

3-43. +28 Volt Supply

3-44. The +28 volt supply employs a half-wave rectifier and capacitor input filter. Q24 controls the conduction of Q23. Since the conduction of Q24 is determined by R61 and R62, output variations produce corrective responses from Q24 and Q23.

3-45. With excessive current, the voltage drop across R60 biases Q25 into conduction. Q25 then takes base current from Q23, maintaining constant current through Q23.

3-46. +220 Volt Supply

3-47. The +220 volt supply employs only half-

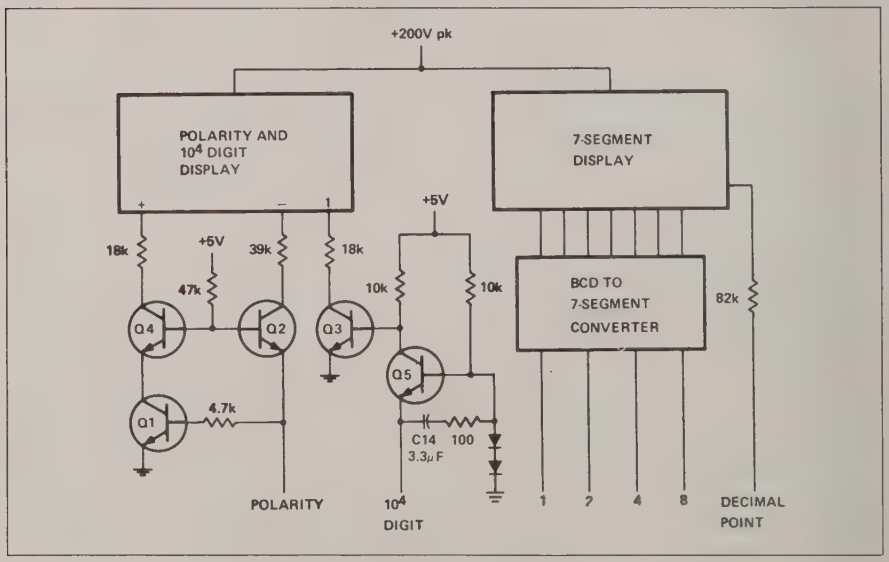


Figure 3-11. Display Circuitry

wave rectification. When the display is operated in dark environments, ionization instability occurs unless one of the display segments is maintained ionized. The bridge rectifier and capacitor input filter supplies ionization current. A decimal point provides the segment. When illumination is not desired, the current supplied does not provide a viewable luminance.

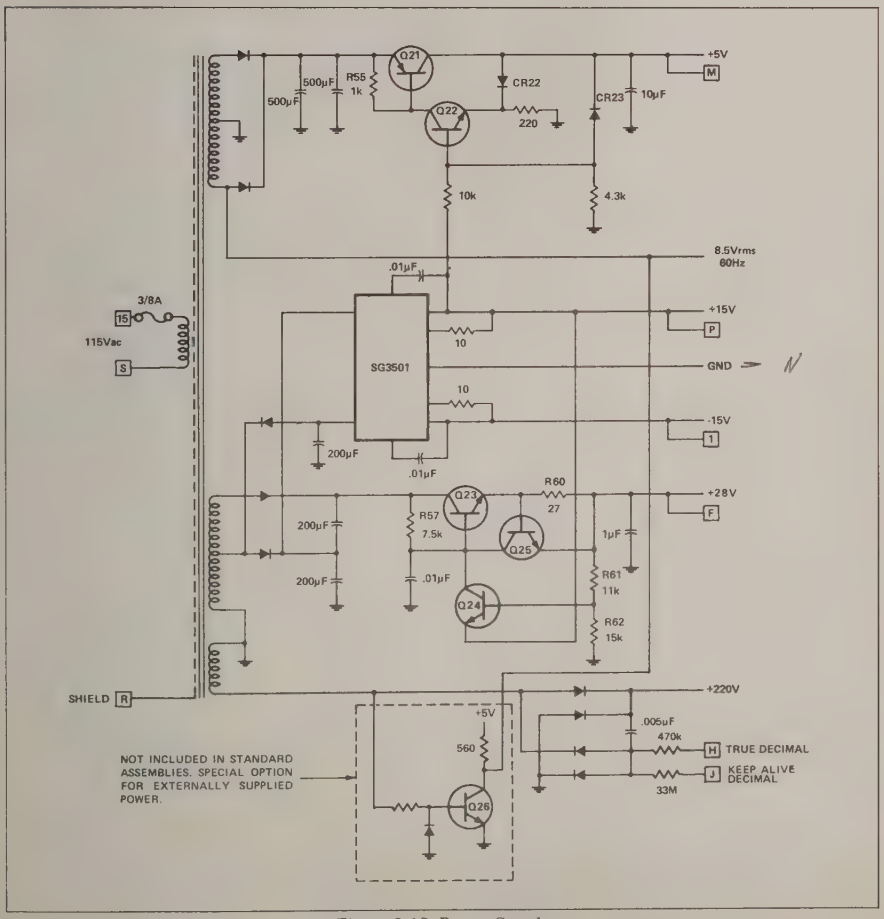


Figure 3-12. Power Supply

SECTION IV

CALIBRATION AND REPAIR

4-1. GENERAL

4-2. The accuracy of the meter should be established at 90 day intervals. Accuracy is confirmed when known inputs yield corresponding displays, within specified accuracy.

4-3. Test Equipment

4-4. Test equipment suitable for calibration or repair is specified in Table 4-1. Substitute equipment must be consistant with the required measurement accuracy.

Table 4-1. Test Equipment

Manufacturer	Description
Data Technology	Model 370 digital voltmeter
Fluke	Model 332A voltage standard
Fluke	Model 382A current standard
Tektronix	Type 545 oscilloscope with Type "W" preamplifier

4-5. CALIBRATION (Figure 4-1)

1. Remove the snap-on bezel.

2. Using the voltage standard for voltmeters and the current standard for ammeters, provide a zero level ANALOG INPUT.

3. Initiate 115 volts ac power ON and allow 20 minutes warm-up.

4. Adjust R9 until the polarity display toggles between "+" and "-." Turn R9 slightly clockwise until the "+" remains ON.

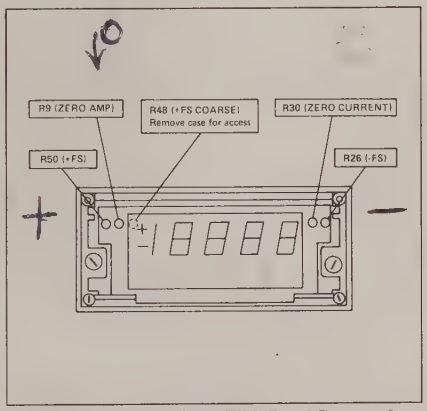


Figure 4-1. Meter Front With Bezel Removed Showing Calibration Potentiometers

5. Set the standard to the level which should yield a 0010 display. Adjust R30 for this display.

6. Return the standard to a zero level. Verify a display of 0000; if not, repeat steps 4 and 5.

7. Set the standard to a level which should yield a display midway between +19997 and +19998, and adjust R50 for a display that toggles between +19997 and +19998.

Note

If the display specified in step seven can not be attained, remove the meter from the case, and adjust R48 (+FS coarse). R48 is located directly to the right of R50 and R9.

8. Set the standard to a level which should yield a display midway between -19997 and -19998, and adjust R26 for a display that toggles between -19997 and -19998.

9. Repeat steps four through nine if necessary, nullifying any interaction of the adjustments.

4-6. REPAIR

Note

Before attempting any repairs, read the warranty provisions and conditions on page iii.

4-7. Section III of this manual devotes a paragraph to each functional block of the meter. Verify operation of these blocks using Section III.

CAUTION

When the case assembly must be removed, difficulty may be encountered in reassembling the unit. This difficulty is due to a taper in both the printed wire boards and the case slots provided for positioning these boards. The slots do not guide the boards into the case until a substantial portion of the board assembly is in the case. Misallignment of the boards is, therefore, likely unless care is taken. The recommended installation procedure is to position the case with the long meter face axis alligned vertically. Rest the boards in the lower slots and gradually slide the board assembly toward the rear of the case while maintaining board allignment with the upper slots. Very slight resistance is encountered with correct allignment. Do not force.

4-8. Factory Repair

4-9. Data Technology maintains a factory repair facility. Factory repairs seldom require more than a week. Experience shows factory repair of equipment to be best, and Data Technology urges customers to only attempt their own repairs when circumstances prevent the return of the meter to the factory. Refer to the customer service card inside the back cover for equipment return instructions.

SECTION V

SPECIAL MODIFICATIONS

(TO BE FILLED IN WHEN UNITS ARE MODIFIED)

DESCRIPTION OF MODIFICATION(S)

CHANGES IN SPECIFIED OPERATION(S)

DRAWINGS APPLICABLE TO MODIFICATION(S)

SECTION VI

DRAWINGS AND PARTS LISTS

(Available separately for OEM users)

6-1. GENERAL

6-2. This section contains schematics, layout drawings, and parts lists for model 4411 and 4412 subassemblies.

6-3. DRAWINGS AND PARTS LISTS

Drawing Number	Title
547949	4-1/2 Digit (Schematic Diagram) Bi-Polar, Model 4412
547948	4-1/2 Digit (Schematic Diagram) Uni-Polar, Model 4411
547844 page 3	Analog Board Assembly, 4-1/2 Digit, Model 4412 (Bi-Polar)
547844 N (ref)	Analog Board Assembly, Parts List (Bi-Polar)
547843 page 3	Analog Board Assembly, 4-1/2 Digit, Model 4411 (Uni-Polar)
547843 L (ref)	Analog Board Assembly, Parts List (Uni-Polar)
547841 page 2	Digital Board Assembly, 4-1/2 Digit, Model 4411 and 4412
547841 E (ref)	Digital Board Assembly, Parts List
547839	Display Board Assembly, 4-1/2 Digit, Model 4411 and 4412
547839 B (ref)	Display Board Assembly, Parts List

CUSTOMER SERVICE AND COMMENT CARDS

The following cards are part of an effort to expand communications between Data Technology and its customers. **Complete and affix the first card to an assembly being returned to the factory.** Send this assembly to Data Technology Corporation, 2700 South Fairview Street, Santa Ana, California, 92704. The second card is for comments on the equipment, technical manual, and service. Entries on this card aid Data Technology in selecting programs consistant with its customer's requirements. Your efforts are, therefore, very much sought and appreciated.

Owner:

Name _____ Address _____

City _____ State _____ Zip Code _____

Equipment:

Model _____ Serial Number _____

Original purchase order number _____ Purchase Date _____

Repair purchase order number _____

Reason for return/malfunction symptoms _____

_____

_____

Name _____ Address _____

City _____ State _____ Zip Code _____

Model _____ Repeat customer: Yes ____ No ____

Delivery: Good _____ Satisfactory _____ Poor _____ Manual: Good _____ Satisfactory _____ Poor _____

Appearance: Attractive _____ Needs improvement _____

Who/What introduced Data Technology: Rep _____ Ad _____ Other _____

Additional features desired: _____

_____

Best liked features: _____

Application: _____

_____

Comments/Suggestions: _____

_____

_____

Enclose with return equipment

Do not mail separately

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